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CONTROLLED EXCHANGE OF CONFIGURATION MANAGEMENT DATA BY INDUSTRY

by

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In response to DOD's ongoing CALS effort, the Joint Engineering Data Management and Information Control System (JEDMICS) was developed as a repository for technical data at government sites with the overall intent of improving access to engineering data and drawings. Although establishment of this system has facilitated the access of government owned, contractor provided data, the majority of information contained in these repositories is still in the form of aperture cards and is not always readily accessible to be "shared" with other potential users.

This thesis will examine the benefits and potential cost savings applicable to the Navy's CALS program. Specifically, the potential cost savings associated with implementing a regionalized, shared JEDMICS database between the Naval Aviation Depot (NADEP) North Island, California, the Naval Air Technical Support Facility (NATSF) in Philadelphia, Pennsylvania, and McDonnell Douglas Aerospace in Saint Louis, Missouri will be discussed. The analysis will begin by reviewing the current and anticipated configuration management requirements for a specific Navy program (F/A-18) using existing information technology. A proposed consolidation of the same technical data between both government facilities and the prime contractor using a shared database with subscription based access will then be analyzed and cost comparisons presented.

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CONTROLLED EXCHANGE OF CONFIGURATION MANAGEMENT DATA BY INDUSTRY

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ABSTRACT

In response to DOD's ongoing CALS effort, the Joint Engineering Data Management and Information Control System (JEDMCIS) was developed as a repository for technical data at government sites with the overall intent of improving access to engineering data and drawings. Although establishment of this system has facilitated the access of government owned, contractor provided data, the majority of information contained in these repositories is still in the form of aperture cards and is not always readily accessible to be "shared" with other potential users.

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I. INTRODUCTION AND BACKGROUND

A. RESEARCH OBJECTIVE

The use of a shared engineering data repository at a single Naval aviation maintenance facility could potentially save that facility $1,700,000 annually. Projected savings throughout the Department of Defense (DoD) by using this same shared repository configuration are in excess of $700,000,000 over a ten year period.

An organization's success depends on the quality and accessibility of its information. This information must be shared among the members of the organization for maximum efficiency and effectiveness. [Ref.1] Through enterprise integration, or the establishment of teamed alliances between the DoD and defense contractors, organizational information is shared via the Defense Information Systems Network (DISN). Data for the organization is created once and used many times. When the latest and best information is available at all times to workers throughout the enterprise, duplication of efforts and cycle times are reduced. Enterprise integration has become a factor in streamlining processes and improving information product quality in both the Government and private industry. [Ref.1]

Enterprise data are dynamically interrelated to the operations of the organization and are constantly evolving. As new information is captured, it is reviewed, commented on, revised, updated, approved, linked to other information, and accessed by enterprise workers, suppliers, and customers, as required. As private industry strives to maximize both efficiency and effectiveness, the use of technology has become an important tool in the implementation of good business practices. [Ref.1.] The same technological advances and business practices employed by private industry are applicable within the DoD's austere financial environment. Use of technology to maximize good business practices results in:

- Just-in-time information or the minimum information necessary to keep an information system running. With just-in-time information the required information arrives at the moment it is needed.
- Disciplined work processes which are standardized throughout the enterprise. This eliminates the requirement for compatibility upgrades and ensures all users are working with the same system.
- An automated, integrated work environment. [Ref.1]

The DoD is one of the world's largest and most dynamic enterprises. Its data and information requirements are enormous as it constantly needs updated, current information on all facets of the military structure from field operations to hardware acquisition. One of the DoD's largest information requirements is managing the data that support its numerous weapon systems. The Joint Computer-aided Acquisition and Logistic Support (JCALS) System was developed to provide the tools for DoD to acquire, manage, access, and update the myriad of engineering drawings, technical manuals, and logistics data that support DoD weapons systems. [Ref.2]

In support of DoD's ongoing CALS effort, the Joint Engineering Data Management Information Control System (JEDMICS) was developed to store technical and configuration management data at government sites with the overall intent of improving product life cycle management. The establishment of this system has reduced the retrieval turnaround time of engineering drawings and facilitated the access of government owned, contractor provided data. Drawings that once required hours for retrieval can now be accessed and reviewed in a matter of seconds. [Ref.3] The

costs associated with maintaining aperture card repositories at multiple government sites in support of this system, however, is expensive. Aperture cards resemble microfiche and are used as a replacement for paper storage of engineering drawings. To date, the DoD has purchased over five million aperture cards which are on file at the Naval Air Technical Support Facility (NATSF) in Philadelphia and seven million aperture cards stored at the Naval Aviation Depot (NADEP) at North Island California. [Ref.4]

Defense contractors, such as McDonnell Douglas Aerospace (MDA), have implemented the DoD's CALS specifications and standards at nominal costs by establishing their own configuration management systems using commercial off-the-shelf (COTS) software and hardware. The cost effective Contractor Integrated Technical Information System (CITIS) developed and operated by MDA, allows customers and suppliers access to data through the use of a shared database.

With the majority of contractor-owned airframe drawings and technical data being generated and modified at MDA for such Navy programs as the F/A-18, T-45 Goshawk, and Harrier, the costs for duplicate storage at government sites in

aperture card format should be addressed. The maintenance costs of aperture card repositories should be compared to those associated with a shared database where engineering drawings and other technical data reside on a single database that can be accessed by both contractor and government users, thus providing the most current and up-to-date information as needed. This analysis would identify the limitations and benefits of both methods.

Of major concern to the government is the security of government-owned drawings and data held at contractor facilities. This thesis will examine the feasibility of single storage on-line repositories in lieu of maintaining aperture card repositories at the Naval Aviation Technical Support Facility (NATSF) in Philadelphia, and the Naval Aviation Depot (NADEP) at North Island.

B. RESEARCH QUESTIONS

The primary research question is as follows:

What is the feasibility of incorporating current technology to improve engineering data access and availability at both government and non-government repositories using a shared database?

The following are subsidiary research questions:

(1) What acquisition issues concerning the electronic delivery of technical data need to be addressed?

(2) What are the advantages and disadvantages of controlled configuration management at a non-government repository versus a government repository?

(3) What are the major cost drivers for the current aperture card storage process?

(4) What, if any, are the cost savings associated with the proposed method of drawing storage and retrieval?

C. SCOPE OF RESEARCH

The scope of this thesis is restricted to examining the access of engineering drawings associated with the Navy's F/A-18 program. It focuses on activities at the Naval Aviation Depot (NADEP) at North Island, the Naval Air Technical Support Facility (NATSF) at the Naval Inventory Control Point (NAVICP) in Philadelphia, and at McDonnell Douglas Aerospace (MDA) in Saint Louis.

This thesis does not address the issue of connectivity between teamed Department of Defense contractors and those sub-contractors who are not CALS compliant. Additionally, the disposition of aperture cards as used by other military services or the Defense Logistics Agency will not be discussed.

D. METHODOLOGY OF RESEARCH GATHERING

The analysis will begin by reviewing the current and anticipated configuration management requirements for a specific Navy field activity aircraft, the F/A-18. A proposed consolidation of the same technical data on a shared database using encrypted, subscription based access will then be analyzed and cost comparisons presented.

Life-cycle cost information for the proposed JEDMICS/Aperture Card system will be obtained through personal interviews and published data from the Naval Aviation Depot at North Island and the JEDMCIS Program Office in Mechanicsburg, Pennsylvania. Information and cost data on the industry CITIS program will be obtained through personal interviews and published data from McDonnell Douglas Aerospace and Aerotech Service Group, Inc.

This study will address the current cost structure of the existing government maintained aperture card repository at NADEP North Island and the potential benefits and cost savings of using a regionalized JEDMICS/JCALS/CITIS shared database over a given life-cycle.

E. ORGANIZATION OF STUDY

The thesis will be divided into four main parts. First, an overview of the current JEDMICS/JCALS/CITIS shared database technology currently implemented by defense contractors, specifically McDonnell Douglas Aerospace, addressing the use of encrypted Internet technology will be discussed. Second, an overview of the current engineering data retrieval process used by the Naval Aviation Depot in North Island will be presented. Third, an analysis of the potential cost savings using a JEDMICS shared database will be presented. And fourth, the potential uses and benefits of shared database technology, with respect to maintenance will be discussed.

F. SUMMARY

This chapter outlined the research objective, questions, and methodology employed in this thesis. Chapter II will provide an overview of the applicable systems used to achieve the interface between both government and industry sites.

II. BACKGROUND

A. INTRODUCTION

This chapter will provide an overview of the systems used in the electronic retrieval of engineering drawings. First, an overview of CALS and the emergence of JCALS, the architecture that enables two distinct system programs to interface will be presented. Next, an overview of how the JEDMICS system is designed for drawing retrieval, how a contractor-developed CITIS system has provided the connectivity between industry and government sites will be discussed.

Prior to 1985, the accepted method of cataloging engineering drawings was the production and maintenance of aperture cards. Aperture cards resemble microfiche in appearance and were widely accepted as a substitute for large paper drawings which required greater storage areas and were more susceptible to damage. Damage usually occurred in the form of tears, smudges, or creases. Although smaller in size than paper drawings, defense contractors, like McDonnell Douglas Aerospace (MDA), were still experiencing similar cataloging problems due to the increasing number of aperture cards produced. Each revision

to any drawing required a new aperture card which was then to be maintained with all subsequent revisions. The maintenance of such an aperture card library required a full time cataloging staff adjacent to the production floor thus facilitating access to drawings by production personnel. In addition to MDA's own aperture card library, military service support activities and the Defense Logistics Agency (DLA) also purchased technical data in the form of aperture cards requiring cataloging and maintenance staffs as well. [Ref.5] As technological advances occurred, military contractors and the DoD began to recognize the potential opportunities that information technology offered in the areas of acquisition, production, logistic support, and, most importantly, in storage and data retrieval.

In February 1992, the General Accounting Office (GAO) published a report describing some of the deficiencies associated with service specific and DLA aperture card repositories:

> Of the 23 contractors we visited, 19 or 83 percent provided us with 34 recent examples of deficient data. This data included 10 examples of illegible drawings, 8 examples of out-of-date information, and 16 examples of inaccurate or incomplete material. [Ref.6, p.15]

Originators of the data itself were also experiencing problems with aperture card quality. At McDonnell Douglas, aperture cards were taken to the production floor for reproduction and review, and were often misplaced or filed incorrectly. This resulted in the establishment of strict accountability procedures which required more time and approval stages to be met prior to the card's actual issue. [Ref.5]

One of the first emerging technologies that MDA recognized and exploited was the ability to digitally scan and transfer drawings into a database known as the Engineering Drawing Storage System (EDSS). The goal of the system was to eventually eliminate the need for aperture card libraries by holding all drawings in a central digital repository. [Ref.5] As advances in Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) technology were made, the EDSS system was expanded to accept digitally designed components directly without having to scan an aperture card. CAD systems use a powerful computer graphics workstation that allows design specifications to be drawn directly onto the display screen. Working with a light pen, scanner, or mouse, designers can specify the product's

dimensions and show its lines, indentations, and other features with precision. Currently, aperture cards for the F/A-18 E/F model do not exist at MDA. All the components for the latest model of this aircraft were designed using CAD technology and directly transferred or "loaded" into the EDSS. [Ref.5] CAD designs are frequently transmitted to CAM systems which rely on information technology to automate and manage the manufacturing process directly. Using the CAD database, CAM software controls tools and machines on the factory floor to actually manufacture the product designed on the CAD system. [Ref.7, p.501]

Although openly accepted and aggressively used by commercial industry, the availability of shared database technology is relatively new to the Department of Defense as introduced by the CALS initiative developed in the mid 1980's.

B. OVERVIEW OF CONTINUOUS ACQUISITION AND LIFE-CYCLE SUPPORT (CALS)

In the mid 1980's, a need to reduce weapon system design time and documentation costs within the Department of Defense evolved into the Continuous Acquisition Life-Cycle Support (CALS) initiative. This initiative sought to address the integration and use of digitized technical data

for weapon systems engineering, manufacturing, and logistics. The CALS initiative is a technology that enables digital technical data to more effectively and efficiently support the acquisition of weapon systems as compared to the paper intensive requirements of the past. A key element of the initiative is to provide common data interchange standards by DoD and industry so that every computer operating system can be used and compatibility between the Government and industry computer languages is achieved. [Ref.8, p.1-3]

Budget cuts and the end of the Cold War have decreased military spending over the past few years. To reduce costs, DoD and industry contractors have used CALS to exchange contract information more efficiently. CALS requires contractors to replace paper documents with computer files and data bases. The files and databases must be linked to DoD computers so that the DoD can review and exchange contract information electronically.

Naturally, contractors (and the DoD) cannot switch from paper documentation to computer networks overnight. To make the transition easier, the DoD will implement CALS in two phases. Phase One requires major contractors to establish

computer and telecommunications networks with the DoD. Phase Two requires contractors to establish networks with sub-contractors and suppliers. [Ref.8, p.1]

According to the "CALS Architecture Study", the sheer volume of technical information is enormous. The study states that nearly one billion aperture cards containing technical data on spare parts for weapon systems, and approximately one million different technical manuals consisting of hundreds of pages of text and illustrations require annual updates of millions of pages. The weapons systems manuals onboard a Ticonderoga-class Navy cruiser reportedly weighed 26 tons. A goal of CALS is to digitize virtually all technical information and drawings for defense equipment and to develop the ability for the Government and industry computers to share that data. [Ref.9, p.3]

As potential applications for shared databases were being explored, it became evident that service specific CALS programs could be linked together in an effort to further standardize CALS applications. This led to the development of the Joint Computer-aided Acquisition and Logistics Support system (JCALS). [Ref.2]

C. OVERVIEW OF JOINT CONTINUOUS ACQUISITION AND LIFE-CYCLE SUPPORT (JCALS)

In 1994, the JCALS Program Office, directed by the Army at Fort Monmouth, NJ., was designated as the lead program office for developing and implementing CALS capabilities, including the Integrated Weapon System Database (IWSDB), throughout DOD. [Ref.8, p.14] The IWSDB was designed to allow remote access by service-specific legacy systems to other systems of another service. For example, a Navy Integrated Logistics Support (ILS) office supporting the F/A-18 can determine spares commonality with the Air Force F-15 through the cross referencing of technical data.

Another challenge faced by the JCALS program was to create an integrated link between acquisition offices, industry contractors, and field support facilities. The method chosen was to link the JCALS system to the defense contractor's Contractor Integrated Technical Information Service (CITIS) gateway or router which then directs the request to MDA's EDSS where the drawing is then digitally delivered to the originator. Under the CALS initiative, defense contractors were required to develop their own CITIS nodes using standardized, COTS software as often as possible. [Ref.3]

The JCALS program is part of the DoD's CALS strategy. The program provides an information management system to support uniform logistic and acquisition engineering, management, material management, and other life-cycle functional processes. The JCALS program provides for an infrastructure which supports a common and integrated structure for organizing data about weapon systems during their entire life-cycles. The system provides applications and services to implement joint functional processes. JCALS strategy is to enable more effective generation, exchange, management, and use of digital data supporting defense systems thereby migrating from manual, paper-intensive, defense system operations to integrated, highly automated acquisition and support processes. [Ref.2]

The JCALS system is data-driven and provides an automated information systems architecture independent of application. JCALS initially meets the Services and DLA's goal of automating technical manual processes and functions. The architecture provides a distributed, open systems environment that make extensive use of a Portable Operating System Interface UNIX (POSIX)-compliant operating system, Government Open Systems Interconnection Profile (GOSIP) and

Transmission Control Protocol/Internet Protocol (TCP/IP) for communications protocols, X-Windows and MOTIF for user interfaces, and Ada for developed software. The architecture is designed for flexibility and growth, and is capable of accommodating additional system requirements, technological improvements, and new functionality. [Ref.2]

At the JCALS sites, hardware and software configurations are dependent on each site's organizations and functions, processing needs, and role in the overall system. Each site is equipped with three nodal segments which will provide the JCALS functionality. The Network Management Segment provides local and wide-area communications processing. The Data Management Segment distributes, manages, updates, and replicates data throughout the system. The Workstation Management Segment delivers the applications and functions to the users' workstations. The system architecture includes a System Operational and Support Capability (SOSC). The SOSC is the central site for user support, system monitoring, life-cycle software support, maintenance, and troubleshooting. It is staffed 24 hours a day to provide operational support and

respond to system user problems or questions as they occur. [Ref.10]

1. Telecommunications Architecture

The JCALS telecommunications architecture provides both local area network (LAN) and wide area network (WAN) capabilities. The LAN provides communications among local users and systems at a site and the WAN provides communications among JCALS sites. JCALS provides the capability for remote and travel users via a modem. The telecommunications architecture provides a dual protocol stack to support both GOSIP and TCP/IP. This approach facilitates communications with existing systems, a large majority of which currently support TCP/IP. JCALS will maintain an open flexible architecture capable of future growth. [Ref.10]

2. Hardware Architecture

The central component of the hardware architecture is the DEC system 3000 (ALPHA) computer, a general-purpose, multi-user, Reduced Instruction Set Computer (RISC)-based system. It features high reliability, advanced RISC technology, high-speed cache, and 290 million instructions per second (MIPS) performance. The hardware architecture

supports an open system computing environment. This environment implements current technology and allows for insertion of new technologies as they are developed. Depending upon site configuration requirements, hardware devices can be added or removed with minimal impact on site operations. [Ref.10]

3. Software Architecture

The software architecture consists of seven functional categories which can be tailored to meet the requirements of each user and organization. Each category is composed of developed software items written in Ada and commercially available non-developmental software items. The major functional architecture software categories include:

- The Application Process Functions component utilizes the Generic Tool Box and provides the functions necessary to support the generation of a variety of system products, as well as design, analysis, and decision support. These generic tools include graphical and textual editors and viewers, Analysis tools, CAD tools, and supportability assessment tool.

- The Work Management Functions component provides users with the capabilities to define and organize work, plan projects, and electronically review, comment on, and approve work under development. The tools include the Workflow, Task, and Workfolder Managers.

- The Information Management Functions component provides users with access to data stored within the system as well as data stored on existing systems. It provides tolls for importing and exporting data in both paper

and electronic formats and capabilities to convert data to CALS-compliant formats. Additionally, the Information Management Functions component provides information configuration management functions for Integrated Weapon System Data Base (IWSDB) data.

- The System Administration Functions component provides the capabilities to monitor and maintain the system, including tools that support security administration, network monitoring, data and data base administration, and problem reporting and follow-up capabilities.

- The User Support Functions component utilizes a graphical desktop which provides an environment for user activation of workbench applications which include an office automation package, context sensitive help, hypertext user help, teleconferencing, and file transfer functions.

- The System Infrastructure Support Functions component includes the operating system, the data base management system (DBMS), a global data management system (GDMS), communications functions, and system security features.

- The Application Implementation Functions component provides the tools and applications for each using organization to tailor the basic system to accommodate its needs. The tools facilitate Document Type Definition (DTD) editing and workflow template generation. [Ref.11, p.6]

4. Integrated Weapon System Database (IWSDB)

The IWSDB is a logically centralized data base that is physically distributed. The IWSDB allows applications and users to access all of the data in the system independent of location, physical storage method, or physical structure of the data. The IWSDB is made up of many logical components.

The logical data model is stored in the Global Directory/Dictionary Data Base (GD/DDB) component of the IWSDB; the catalog is stored in the Reference Library component of the IWSDB; and the logistic technical information is stored in the Technical Information Data Base (TIDB) component of the IWSDB. The TIDB is composed of two distinct elements:

1. data that is physically resident on the JCALS system.
2. data that is virtually resident on the JCALS system.

Data that is physically resident is subject to the configuration management and data management policies of the system. Data that is virtually resident is governed by the proponent or owner of that data. Existing systems, which provide the virtually resident data, retain ownership and control of their data while allowing the JCALS system to access and use that data.[Ref.11 p.13]

D. OVERVIEW OF JOINT ENGINEERING DATA MANAGEMENT INFORMATION CONTROL SYSTEM (JEDMCIS)

Simply stated, the JEDMICS system is an on-line repository of aperture card drawings scanned into a database for the purpose of storage, retrieval, and modification. Modification to drawings is done through the use of a Work Flow Manager Application Program Interface (API). The

amount of data stored directly on the JEDMICS hard drive depends on the amount of memory available. Due to the predominantly graphic nature of engineering drawings, large amounts of memory are required for hard drive storage. Large hard drive memory requirements are offset by the use of optical disk secondary storage or "Jukeboxes". Jukeboxes are banks of optical storage disks in either standard 'write once, read many' (WORM) format or, in the case of newly developed drawings, a 'write and read' capability which allows the drawing's originator to make revisions as required. [Ref.5]

JEDMICS is the DoD's standard repository for the management and control of engineering data. JEDMICS provides the means for DoD organizations to efficiently convert, protect, store, manage, retrieve and distribute information previously stored on hard copy or in legacy systems. As the designated DoD's standard repository, JEDMICS provides fully integrated access for other DoD standard systems and applications involved in the creation, management, and use of engineering data. [Ref.12]

Initially identified for 47 Navy, Marine Corps, and Defense Logistics Agency sites, JEDMICS was extended to the

Army and Air Force through the Corporate Information Management (CIM) initiative in November, 1991. The JEDMICS system is functionally grouped into six different subsystems: Input, Data Integrity, Index, Optical Storage, Workstation, and Output. Information regarding the operations of each subsystem was gathered in a series of telephone interviews with the JEDMICS Program Office and is described below.

1. JEDMICS Subsystem

a. Input Subsystem

The Input Subsystem is the primary entry point for scanning drawings, aperture cards, and documents into JEDMICS. The major hardware components include (1) large format scanners which can scan paper, vellum, and mylar drawings; (2) dual-sided page scanners which will scan 8.5″ x 11″ documents at an effective rate of 1200 pages per hour; and (3) high-speed aperture card scanners which scan at an effective rate of 425 cards per hour.

b. Data Integrity Control

The Data Integrity Control Subsystem provides for the processing of scanned images that temporarily reside on magnetic storage while awaiting quality assurance on Data

Integrity Control Workstations (DICWs). The primary processing steps include quality assurance verification of data and the transfer of images to permanent optical storage.

c. Index Subsystem

The Index Subsystem provides for the inquiry and access of image-related index information being scanned into the JEDMICS system. This takes place through the use of a COTS relational database and forms processing software.

d. Optical Storage Subsystem

The Optical Storage Subsystem provides for the storage of image data on both multiple disk autochangers, jukeboxes (14-inch platters) and stand alone single disk devices (14″ and 5.25″). The jukebox is capable of handling the storage for up to 6 million JEDMICS images. The stand alone disks provide backup for the jukebox and are a means of exchanging data between sites.

e. Workstation Subsystem

The Workstation Subsystem provides the capability to access images that reside in the Data Integrity Control and Optical Storage Subsystems. The Multifunction Graphics Display Workstation provides the ability to view an image

and direct output to a hardcopy printer. The multifunction capability of the workstation allows the user to access different systems from the same desktop platform. Other systems include the Engineering Graphics Display Workstation (EGDW) which provides a true raster editing capability, and the Video Display Workstation (VDW) which provides access to index information remotely and can initiate output requests for engineering data.

f. Output Subsystem

The Output Subsystem provides for a variety of output devices and media types for JEDMICS engineering data. Output capabilities include aperture card production, high-resolution hardcopy plotting, large-format printing, and high-speed printing. The aperture card plotters must collectively have the capability to produce 200 aperture cards per hour for images stored on JEDMCIS. The main feature of the high-resolution plotter is the capability to output drawing sizes A through K. [Ref.12]

2. JEDMICS Application Program Interface

In the time since JEDMICS was designated as the DOD's standard repository for engineering data, a number of automated systems involved in the generation, management and

use of engineering data have identified a requirement to interface with JEDMICS repositories for the storage and retrieval of engineering data. These systems include JCALS, Computer Aided Design-2 (CAD-2), Configuration Management Information System (CMIS), Base-lined Advanced Industrial Management (BAIM) and the Automated Bid-Set Interface. Because of the diversity in the applications which require support and the uncertainty of the requirements for future systems, it was determined that the use of a single Application Program Interface (API) would provide the most application support. [Ref.12]

The API was designed to provide access to JEDMICS from non-JEDMICS workstations or servers. With an API, the majority of functionality of JEDMICS can be realized. At a high level, these capabilities include index querying, engineering drawing retrieval, quality assurance operations, and output requests. The API is based on a "client-server" model and uses standard TCP/IP services to provide application support over any Ethernet or token ring local area network (LAN). Additionally, if the LAN is connected to either a Metropolitan Area Network (MAN) or Wide Area Network (WAN), any accessible JEDMICS repository will have

the capability of providing services to the client application. Any application whose host is able to use TCP/IP sockets is a potential JEDMICS repository client. This freedom will enable the JEDMICS repositories to support existing applications and any future applications without any reworking of the JEDMICS repository servers.[Ref.12]

E. OVERVIEW OF CONTRACTOR INTEGRATED TECHNICAL INFORMATION SYSTEM (CITIS)

The Contractor Integrated Technical Information Service (CITIS) is a contracted line item that is designed to provide a single entry point for authorized Government access to and delivery for contractor data in response to a valid Contract Data Requirements List (CDRL). The initial concerns over development of a CITIS node were cost and security. For major DoD contractors such as MDA, cost was not as big a factor as security. MDA contracted out its CITIS development effort to Aerotech Services Group, Inc., a St. Louis firm that developed a secure, cost effective CITIS node using COTS hardware and software. It has proven so successful for the prime contractor that over 2800 sub-contractors and suppliers have established CITIS accounts. [Ref.3]

1. Security

Security issues were addressed through the establishment of CITIS "accounts" at both ends of the network. Accounts are established for each user in such a manner that requested information will be routed only to authorized servers which in turn transmit the data to an authorized remote terminal. If an account number is compromised and used from an unauthorized terminal, the request will reach the MDA CITIS router which will then verify the requesting terminal's access. Upon determining that the requesting terminal does not have access, the request will be terminated. Additionally, accounts are established based on the potential user's access level for the data requested. This allows tailored access to certain data. [Ref.10]

Instead of program and product documentation (typically paper deliverables) being prepared and submitted, the same documentation may now be viewed and manipulated by government reviewers and users at workstations on an automated communication network. Information available includes items generated by the contractor, its teaming

partners, subcontractors, vendors, suppliers, and customer furnished information.

2. Access

The CITIS node, as currently implemented at MDA, is a UNIX workstation which uses specialized software to provide a "logical node" (a gate or path) for a single point of access to MDA computer systems. With a computer, proper communications, and access authorization, it is possible to access MDA's networks, applications, and stored data through CITIS. CITIS provides a connection to the mainframe that allows remote computers to act like a mainframe terminal or workstation. When remote access to CITIS is made, the user's screen looks the same regardless of the type of system being used ie; a DOS-based personal computer, a UNIX workstation, or a MacIntosh. [Ref.3]

CITIS permits the DoD and MDA to view and exchange information electronically. By providing subcontractors and suppliers with CITIS access, they, too, are able to send and receive contract information without the limitations of paper.

3. File Transfer

Whether working with word processors, spreadsheets, or Unigraphics (UG), files can be transferred to other CITIS users utilizing File Transfer Protocol (FTP) software to identify the type of file and move it with formatting intact. The Process Specification System, Unigraphics, and other applications are installed on MDA mainframes and Unigraphics workstations. Before CITIS, users had to have access to a mainframe terminal or a UG workstation to use those systems. With CITIS, users can access them on a remote PC or MacIntosh with proper authorization. This is known as 'remote access' because the software is on another remote machine. CITIS allows two distinct users to view the same file at the same time. For example, suppose a drawing is created in Unigraphics at MDA in St. Louis and needs to be shown to an engineer in California. Using CITIS and a software program called SharedX, the drawing can be viewed simultaneously by both users and 'live' changes can be made to the drawing at both sites. [Ref.10]

There are two types of CITIS users: network users and remote site users. The CITIS node resides on the MDA Metropolitan Transport Network (MTN) which allows access to

all of MDA's computing environment. Authorized MDA personnel can use the MTN to access and share information with other authorized users. Remote site users are not attached to the MTN and therefore must 'dial into' the CITIS node using a modem and a phone line or connect through another network, such as the NAVWAN or the Internet in the case of government users. [Ref.10]

With the JCALS and CITIS infrastructure in place, the next phase was to demonstrate that JEDMICS could be linked with a contractor's CITIS node through JCALS for the purpose of digitally transferring data.

F. CONNECTIVITY

The network used to connect the JEDMICS/JCALS/CITIS architecture is the Navy Wide Area Network or NAVWAN which is a sub-network of the Defense Information Systems Network (DISN). The DISN is a 'private' network operated by the DoD. The term 'private' is used in reference to the access requirements needed to get on the network. The NAVWAN is simply a block of Internet Protocol (IP) addresses that are common to the Navy. [Ref.10]

In order to gain access to the CITIS node at MDA, the remote JEDMICS user must first enter the correct Internet

Protocol or IP address. The JCALS server then acts as a barrier or "firewall", screening the network for the correct incoming address that has been cleared for access. Once a request or address has been recognized and verified, the JCALS server will then 'route' the request to the CITIS server at McDonnell Douglas where the requested drawing information is pulled from the EDSS and forwarded back to the originator. [Ref.10]

Transmission speed of the requested drawing depends on the size of the file and the bandwidth of the network line. At the time of demonstration, smaller drawings took only seconds to download while the largest size took up to five minutes. [Ref.10]

G. JEDMICS/JCALS/CITIS

With the three distinct systems in place, the next phase was to establish a standardized connection that all services could use. Within the Navy, the F/A-18 program was designated as the pilot program for this interface. In 1994, support activities at the Naval Aviation Depot (NADEP) in North Island and the Naval Air Technical Support Facility (NATSF) at the Naval Inventory Control Point (NAVICP) in Philadelphia were chosen as the sites for JEDMICS/CITIS

connection to MDA through JCALS. The successful JEDMICS/JCALS/CITIS interface at NADEP North Island was anticipated to be completed sometime in June, 1996. On August 29, 1996, the interface was completed and NADEP North Island successfully downloaded engineering drawings from MDA's CITIS node via JCALS. NATSF implementation has been suspended due to a planned relocation to North Island in 1997.

H. SUMMARY

This chapter has provided an overview of the systems and applications that have resulted in the seamless retrieval of engineering drawings. Chapter III will present an overview of the current F/A-18 Material Discrepancy Reporting process at the NADEP North Island, CA. and the effects of the JEDMICS/JCALS/CITIS shared database implementation on the process.

III. F/A-18 PILOT PROJECT

A. INTRODUCTION

This chapter will present an overview of the current work flow process for a specific Navy aircraft, the F/A-18, at NADEP North Island. The information presented in this chapter was obtained from interviews with data support engineers and analysts at NADEP North Island. The electronic transfer of technical manual data and engineering drawings using JCALS technology was successfully demonstrated during both the design and production phases of the DDG-51 Aegis program. These same applications are now being implemented and expanded as part of a pilot project for the F/A-18 program.

The purpose of the project is to develop and demonstrate electronic access to F/A-18 technical data, engineering drawings and technical manuals, no matter where they are located, and making them transparent to the user. The end user does not need to know the characteristics or location of the repository data to be able to access and use the information. Technical data, such as engineering drawings and technical manuals, will be accessed via several different drawing and technical manual repositories.

Engineering drawing repositories include JEDMICS and McDonnell Douglas' EDSS repository for F/A-18C/D's. Technical manual repositories include the Naval Air (NAVAIR) Automated Technical Information System (ATIS) located at NATSF. [Ref.13]

The F/A-18 Cognizant Field Activity (CFA) at NADEP North Island and the Navy ICP, Philadelphia will have the ability to access technical data electronically using DoD standard systems such as JCALS, JEDMICS, and CITIS. JCALS will provide the connectivity for users to pull and view engineering drawings from the applicable repository using a standard JCALS desktop user interface. The use of JCALS workflow management will provide the capability for the technical data to be viewed, marked up, and forwarded via electronic work folders to other IPT members using pre-defined work process templates. To provide access to configuration management data, the Configuration Management Information System (CMIS) will be integrated into the JCALS desktop. This will give the user the ability to identify the required component and drawing using CMIS and pull the drawing into view in one seamless application. [Ref.2]

To demonstrate the capabilities and benefits of an integrated JEDMICS/JCALS/CITIS system, a review and analysis of Fleet Hazardous Material Reports pertaining to F/A-18 aircraft was conducted. These reports were used due to the comprehensive technical review required to investigate the failure of installed components.

B. F/A-18 MATERIAL DISCREPANCY REPORT (MDR) PROCESS

All MDRs are initiated by messages that arrive at the NADEP through the Standard Naval Messaging System. All messages received are considered for "official use only". Messages are usually unclassified, with a small number changed to "classified" due to sensitive deployment location or exercise. A small number of manuals and drawings are also considered classified.

Approximately two hundred messages arrive daily. Out of those two hundred, about five are considered Hazardous Material Reports (HMRs) and, in one year, about six turn into Engineering Investigations (EIs) for structure components. The message may arrive without a specific request or any request for action at all, or it may arrive as a request for MDR action. Messages arrive in digital form, but are then immediately printed out and distributed

to the appropriate Integrated Process Team (IPT) leader. Incoming messages are sorted first by criticality. Critical messages, those that may have a readiness impact on aircraft, receive attention first. The status of a message is also tracked by entry in the database. The type of MDR a message "turns into" is noted and statistics are maintained. Over the past two years, the most common type of MDR received was a Hazardous Material Report (HMR), followed by the Technical Publication Deficiency Report (TPDR), then an Engineering Investigation (EI) request, and finally a Quality Deficiency Report (QDR). [Ref.13]

The message retrieval process is a rotating duty and can take all day to complete. Duty officers at NADEP receive messages from the fleet 24 hours a day which are then forwarded to the appropriate IPT leader based on priority and urgency of need. The IPT leader decides which functional area or individual the message will go to. Every one of the messages is screened for the possibility of further investigation. The following numbers reflect activity on the F/A-18:

Calendar Year 95

HMR/EIs Received	122
EI Requests Received	9
EIs Opened	9
EIs Denied	0

Calendar Year 94

HMR/EIs Received	161
EI Requests Received	14
EIs Opened	9
EIs Denied	5

The engineer, who is the subject matter expert, works with the logisticians, the technical data managers, and other engineers as necessary. Typically, the engineering staff takes the initial action in processing MDRs yet there are instances when the logistician will take the lead. Approximately 90 people are involved in the MDR process at the F/A-18 NADEP, 60%-70% of who are engineers. [Ref.13] The current F/A-18 MDR process is displayed in Figure 1.

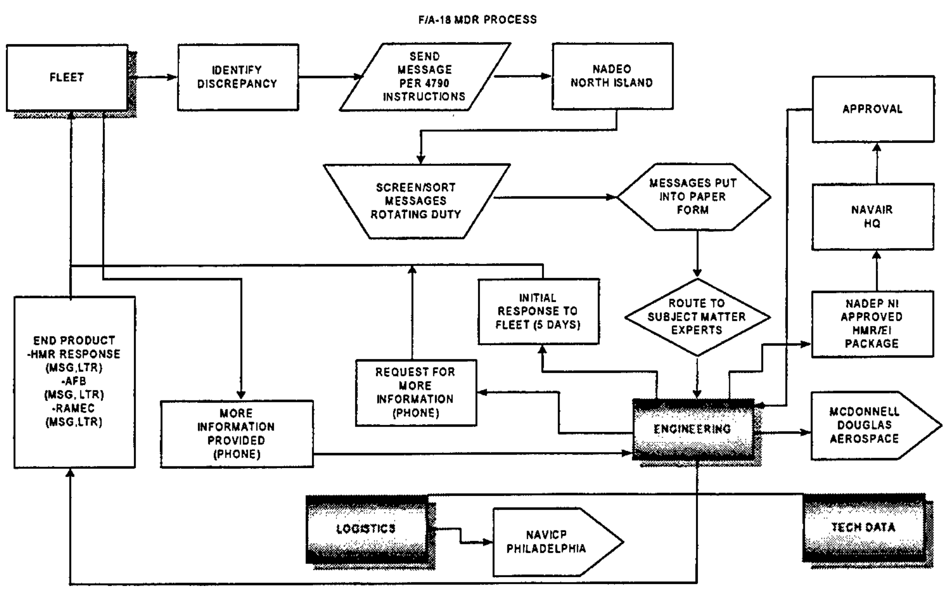


Figure 1. Current F/A-18 MDR Process

1. Approval Process

Approval for action taken needs to be routed through representatives from the engineering, logistics and the technical data departments. This means that each of these areas must have a 'chop' on the recommended fix or solution. This process is extremely lengthy and is considered the longest step in the process. Currently the review process is conducted in a series of passing actions to the next reviewer in the 'chop chain'. There are several alternatives that can be taken after review of the initial message.

a. No Response Required

Many incoming messages do not require a fix or even a response. In these cases, the messages are simply filed for recordskeeping.

b. HMR Response

A response may be generated if an action was requested or not. The response, in the form of a standard Naval Message, details the fix to the problem in textual form. The response will address a one-time specific action that is simple in nature. A follow-up phone call usually closes out this type of response.

c. EI Initiation

An EI is initiated either by the fleet or by the NADEP. An exhibit is required to accompany the incoming message of a material discrepancy. The exhibit is usually the failed part or component, and either arrives with the message or is requested by NADEP by phone or message. The NADEP staff may also determine that a request for an EI is unfounded and denied. The originator is notified via message or phone call of the decision.

d. Rapid Action Maintenance Engineering Change

Fleet activities are sent Naval messages and/or a letter to effect one-time weapon system-wide engineering changes.

e. Air Frame Bulletin (AFB)

A Naval message is sent to fleet activities describing the bulletin and a letter with enclosed material is sent to NATSF for the F/A-18 C/D models. A technical manual change will be incorporated with the new information.

f. Air Frame Change (AFC)

An AFC results from an Engineering Change Proposal (ECP), which is run with the involvement of the program office. Again, NATSF is sent a letter with enclosed

material for changes to the C/D models and a technical manual change results. Changes in engineering models and drawings are sent to NATSF as well. At this time, there are still many drawings sent in paper form.

The overall time taken to complete MDR activities varies. Some Naval messages, requiring no response at all, take only a few minutes to process. The other extreme is an AFC which often requires 2 months to a year to complete the actions associated with that specific MDR. [Ref.13]

C. THE DETAILED F/A-18 MDR PROCESS

1. Engineering

a. Purpose

The engineering subject matter expert receives the Naval message from the IPT leader and determines if a problem exists that warrants action such as an EI to resolve the discrepancy.

b. Internal Interfaces

The engineer works with the logistician to determine part reliability and the supply history of the affected system. At the same time, the technical data manager will assess whether the maintenance procedure in the repair

c. Data Collection

Initial data is received through incoming Naval messages yet a majority of incoming messages lack complete information regarding the discrepancy. When this occurs, follow-up phones calls or messages are sent to the originating activity to obtain additional information. Once all the initial data is received, historical data is accessed from the engineer's file or tracking database. Drawing data is also collected through the NADEP aperture card drawing repository, the NADEP JEDMICS system, on-line dial-up connection to the NATSF JEDMICS system, or phone calls to MDA support engineers who will send the requested drawing information through facsimile or mail. Logistics data is collected from the NADEP logisticians and the Navy ICP, Philadelphia. Technical manual data to identify potential maintenance procedure problems is collected from NADEP technical data managers or from NATSF. All of the data collected resides on various media including paper files, paper plots, paper fax, voice, and digital access.

d. External Interfaces

External interfaces are primarily administrative in nature and are generated by engineers requesting technical

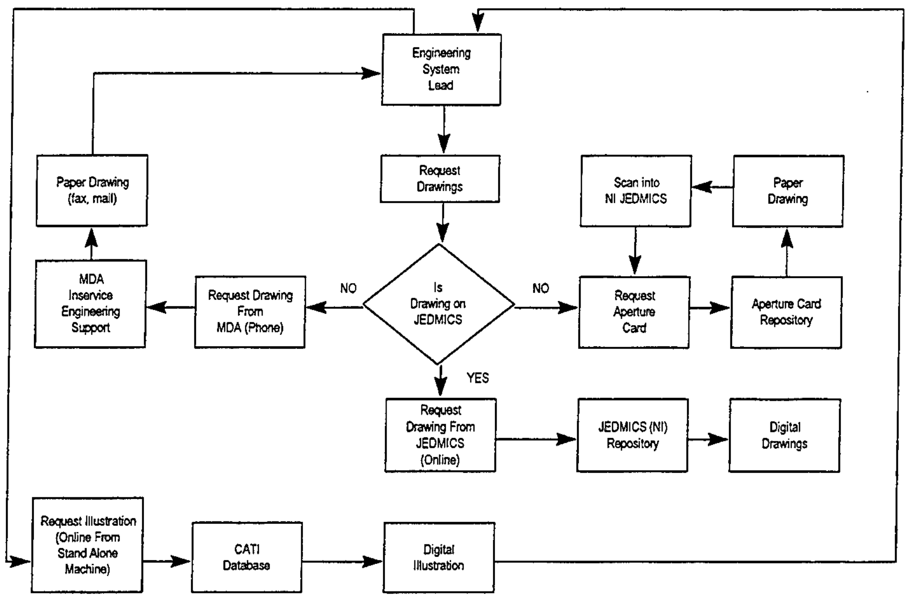


Figure 2. Engineering Interface Process

2. Logistics

a. Purpose

The logistics subject matter expert receives a request for information from the engineer. The job of the logistician is to determine the logistics impact of a fleet-reported hazard and to assess the system reliability, supply status, and impact of any recommended engineering changes.

b. Internal Interfaces

The logistician works directly with the engineer to ensure that the resulting action integrates engineering and logistics concerns. Additionally, the logistician works

with the technical data manager to determine whether the proposed solution will affect the existing maintenance procedure.

c. Data Collection

Initial data is typically received through the engineer who receives the incoming Naval messages. On occasion, the logistician may receive the message directly. Reliability data is received through the NALDA database. Drawing data may also be collected through the NADEP aperture card drawing repository, the NADEP JEDMICS system, on-line dial-up connection to the NATSF JEDMICS system, or phone calls to MDA support engineers who send drawing information through facsimile or mail. The data may be collected by the engineer and utilized by the logistician. Logistics data is also collected from the Navy ICP, Philadelphia and technical manual data is collected from NADEP technical data managers or from NATSF to identify potential maintenance procedure problems.

d. External Interfaces

Logisticians interface with Navy ICP, Philadelphia to receive logistics and reliability data as well as with

fleet personnel who generate the Naval messages. [Ref.13] The logistics interface process is displayed in Figure 3.

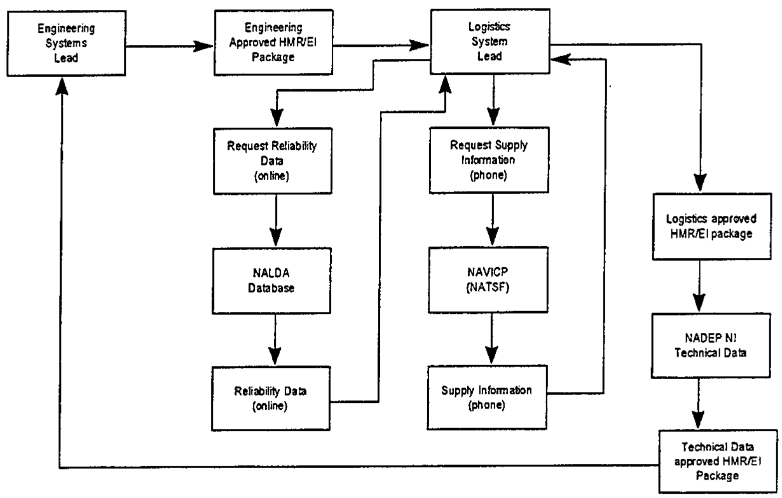


Figure 3. Logistics Interface Process

3. Technical Data

a. Purpose

The technical data manager receives a request for information from an engineer or logistician. The job of the technical data manager is to supply configuration information, make configuration changes and distribute technical manuals.

b. Internal Interfaces

The technical data manager works with the engineer and logistician to investigate a maintenance instructions

impact on a discrepancy reported by the fleet. The technical data manager will also work with the engineer and logistician to make required changes in the technical manual documentation.

c. Data Collection

Initial data regarding the MDR is received from the engineer and logistician who receives the incoming Naval messages. Technical manual data for the A/B aircraft resides in-house, but the C/D aircraft data resides at MDA. If drawings are needed and NADEP North Island is not considered the Cognizant Field Activity (CFA), then the NATSF JEDMICS Manager and repository must be added to this process.

d. External Interfaces

The technical data manager interfaces with NATSF and MDA to receive and transmit technical data. The technical data manager may also interface with the fleet and those field activities which need technical manual updates. [Ref.14] The technical data process is shown in Figure 4.

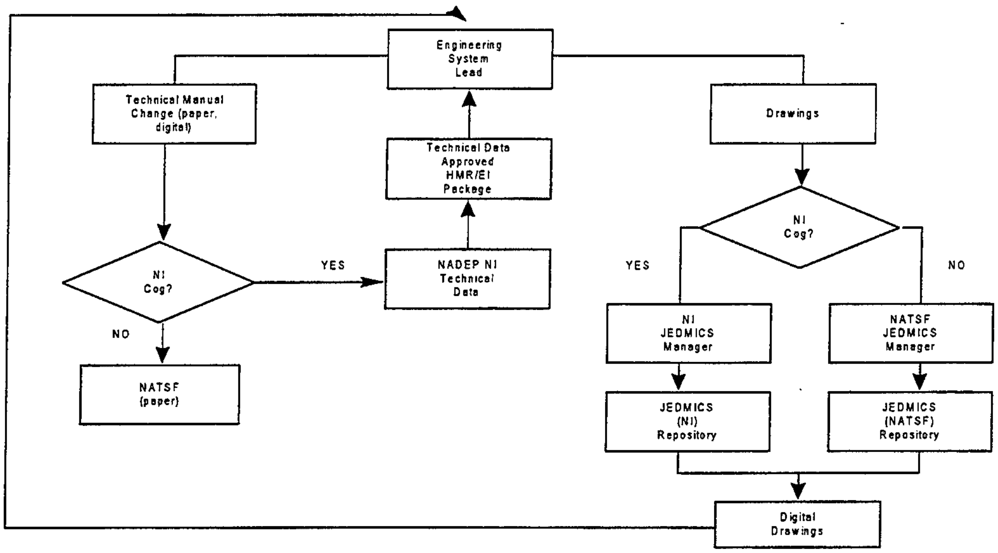


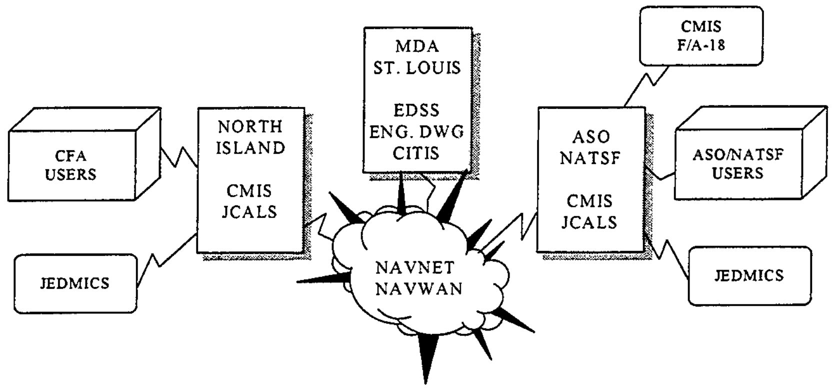
Figure 4. Technical Data Process

D. THE NEW PROCESS

As reflected in the previous section, the current process is paper intensive and requires numerous collaborations between engineers, logisticians, and technical data managers to determine the cause of a failure and recommend corrective action. Using the JCALS/JEDMICS/CMIS system, engineers at NADEP North Island will pull up the component drawing using the JCALS viewer to aid in the analysis. Based upon the results, the system engineer may document the drawing with red lined annotations, and then forward it via an electronic folder to an ILS engineer with a request to study the maintenance manual to determine if installation instructions contributed

to the premature failure. The ILS engineer can pull the technical manual work package into the JCALS viewer from the master ATIS repository at NATSF, study and add comments via the graphics viewer and send the work package back to the system engineer. Simultaneously, the same information can be forwarded to the F/A-18 data manager at NATSF indicating a suspected problem in the wording of the installation instruction.

If an inherent material design deficiency is suspected, the system engineer can forward the electronic work package to the Navy ICP, Philadelphia weapons system item manager who can then review it for contractual waivers or other quality deficiency items. The resulting engineering investigation can be shared with the IPT headquarters team electronically if the investigation leads to a potential Engineering Change Proposal (ECP) or flight performance restriction. [Ref.13] The proposed JEDMCIS/JCALS/CITIS interface is displayed in Figure 5.



F/A-18 PILOT PROJECT TECHNICAL ARCHITECTURE

Figure 5. JEDMICS/JCALS/CITIS Architecture

E. SUMMARY

This chapter discussed the Material Discrepancy Reporting process for the F/A-18 aircraft and the related interfaces between engineering, logistics, and technical data personnel at the NADEP North Island CA. Chapter IV will present the potential cost savings associated with the implementation of JEDMCIS/JCALS at this same facility.

IV. COST DATA ANALYSIS

A. INTRODUCTION

This chapter will discuss the function of NADEP North Island's engineering data repository and the potential cost savings associated with the implementation of JEDMICS. The cost savings will be presented in the area of repository configuration and user configuration, and is taken from historical data provided by both NATSF in Philadelphia and NADEP North Island.

NADEP North Island's central repository operations are conducted within the Production Support Directorate, Technical Services Division, and Data Support Branch. There are six satellite repositories known as Technical Data Centers (TDCs) which are subordinate to the Technical Data Branch. Aperture cards are produced by the Defense Printing Service's North Island Detachment. Preparation of technical data packages and bidsets is done by the Navy Inventory Control Point (NAVICP) located in Philadelphia. [Ref.14]

The NADEP North Island central repository receives engineering data from NATSF in the form of aperture cards. If NADEP North Island receives a paper drawing or aperture card from a contractor directly, a duplicate aperture card

is produced by NADEP's Defense Printing Service and the card is sent to NATSF for filing. [Ref.14] NATSF is the Navy's engineering data repository for all Navy aircraft and provides NADEP North Island with data for which it has Cognizant Field Authority (CFA). [Ref.1] Currently, NADEP North Island is the CFA for the Navy's F/A-18, E-2, C-2, and S-3 aircraft.

The NADEP North Island engineering drawing repository is the control point for engineering data received from within the depot, from other government agencies, and from commercial industry. It is also the depot's control point for engineering drawing data requests from within the depot, from other government agencies, foreign military activities, and commercial industry. The repository also provides for the duplication and distribution of both aperture cards and paper drawings to both the internal and external activities mentioned above.

NADEP North Island manages approximately seven million aperture cards. Of this total, approximately 5.6 million are considered active. An active drawing pertains to a component that is still being produced whereas an inactive drawing is held to ensure that a component, although no

longer produced by a contractor, can be acquired if the need arises. [Ref.14]

B. CURRENT REPOSITORY CONFIGURATION

Aperture cards at NADEP are currently stored in twelve enormous rotating filing cabinets or lectrievers, and are filed by aircraft type and number. Prior to the implementation of JEDMICS, a drawing request required an individual to manually locate the drawing, pull the aperture card, place the aperture card in one of ten readers, and print out the required information. Once the required information was obtained, the card had to be correctly filed back into the appropriate drawer in the lectriever. This process led to what is commonly referred to as a "ghost repository". Aperture cards that were frequently requested were often held at locations for easy access rather than be refiled. A "ghost repository" results from stockpiling aperture cards at various locations in order to avoid walking to the central repository to place a request. [Ref.14]

A specific breakdown of the total costs associated with implementing JEDMICS at the NADEP North Island was unavailable. However, cost data was available for the DoD

wide implementation of JEDMICS and is presented in Appendix B. It is estimated that 100 14" platters will be required to store the information contained on the 7 million aperture cards currently filed at NADEP North Island. Each platter costs approximately $500 dollars and has the capacity to store 10 gigabytes of information. [Ref.14]

C. POTENTIAL JEDMICS REPOSITORY CONFIGURATION

As previously mentioned, NATSF in Philadelphia is the central repository for engineering data for all Navy aircraft. As new aperture cards are received, they are duplicated and sent to the appropriate CFA or NADEP. The duplication and forwarding of cards does not come without expense. The following overview presents cost data savings related to the elimination of aperture cards using Electronic Data Interchange in the form of JEDMICS.

1. Elimination of Aperture Cards

Aperture cards received at NATSF are distributed to the appropriate NADEPs and other designated field activities for filing and storage. If a San Diego activity cannot locate the required aperture card at NADEP North Island, it must be mailed from NATSF in Philadelphia. A regionalized JEDMICS repository located at NADEP North Island would eliminate the

requirement to mail aperture cards from NATSF Philadelphia to San Diego area users.

a. Scenario

NATSF provides central repository services for all Naval Air activities including NADEPS, contractors, and other activities requiring engineering data. NATSF received JEDMICS in 1994 and will continue to be the focal point for delivery of data from defense contractors and vendors doing business with NADEPs and other government activities. Since receiving the JEDMICS, NATSF has been in the process of loading all NADEP North Island data onto 14 inch platters for transfer. Under a regional concept, all other data pushed to the San Diego region could also be loaded into the JEDMCIS system at NADEP North Island. [Ref.15]

NATSF pushed approximately 8 million aperture cards out to NADEPS and other requesting activities within the Navy during FY 93. NADEP North Island received 395,000 of that 8 million. Other external customers of NATSF in the San Diego area include Miramar Naval Air Training Station, 32nd Street Naval Support Station, organizations located directly on NADEP North Island, as well as subcontractors located in the San Diego area. These customers of NATSF pay .85 cents for

every aperture card received. This cost was determined by NATSF and includes material, labor, overhead, and facilities.

b. Benefit

The implementation of JEDMICS will eliminate the requirement for NATSF to send aperture cards to NADEP North Island. The possibility exists that NADEP North Island could become a regional center for the storage of all drawings currently being distributed to Navy activities located in the San Diego area.

c. Savings in Aperture Card Mailing

The total saving alone for using JEDMICS versus the development and mailing of aperture cards by NATSF will be $335,750 (.85 * 395,000 cards).

2. Elimination Of The Requirement To Make/Receive Phone Calls

Drawing users are scattered through the NADEP North Island and San Diego area. Requests for drawings are frequently made by phone calls received at the central repository. An on-line access to the JEDMICS system by authorized users would eliminate the time required to place and receive phone calls.

a. Scenario

The current technique utilized by NADEP North Island users to acquire drawings requires three specific categories of request:

DRAWING QUERY - Receive the call, research the drawing, view the drawing and respond.

THE ORDER - Repository personnel receive the customer order and filling out the order form.

NOTIFICATION - A call from the repository to the user informing him/her that the drawing is ready for pick up.

At the request of the Repository Supervisor, the personnel kept a log of the average time for each response for a total of 30 days. The results of the log were captured in an average time for each request to be processed at the repository end and included the following:

DRAWING QUERY - 8 Minutes
THE ORDER - 6 Minutes
NOTIFICATION - 3 Minutes
AVERAGE CALL - 6 Minutes (.10 Hours)

The number and category of calls captured during that 30 day timeframe were recorded as follows: [Ref.16]

INCOMING CALLS - 40 Daily
ORDERS RECEIVED - 46 Daily
NOTIFICATION - 39 Daily
TOTAL - 125 Daily

b. Benefit

JEDMICS will eliminate the requirement for the receipt of phone calls by the repository and the time required to make those phone calls from the user community.

The key strokes necessary to acquire the drawings through JEDMICS would be insignificant compared to the process of calling and waiting for repository personnel to determine if the drawing is available, filling out the order form, and collecting drawings as requested.

c. Savings in Phone Call User Configuration

125 Calls Daily (40 + 46 + 39)
.10 Hours Per Call Average
251 Days Yearly
Hourly Wage $27.14 (GS-11/5, salary + fringe)

Calculations:

125 * .10 = 12.5 Phone Hours/Day
12.5 Hours Daily * 251 Days = 3137.5 Phone Hours/Year
3137.5 Phone Hours/Year * $27.14 = $85,152 Yearly
$85,152 (process time) * 2 (outgoing phone calls) =
$170,303.

There will also be a cost involved in making the call by the user. An average of 3 minutes (.05 hours) was used to determine the amount of time external users required to request information or initiate drawing orders. That charge is described as follows:

Calculations:

125 * .05 = 6.25 Hours Daily
6.25 Hours Daily * 251 Days = 1568.75 Hours Yearly
1568.75 Hours Yearly * $27.14 = $42,576 Yearly
$170,303 - $42,576 = $127,727 Savings Yearly

D. CURRENT USER CONFIGURATION

In addition to the central repository, NADEP North Island personnel can obtain engineering drawings from six satellite Technical Data Centers (TDCs). Personnel use the nearest facility. Without them, personnel would have to travel to the central repository, which varies in distance from their workplaces. [Ref.14]

Some TDCs are manned while others are not. At the manned TDCs, TDC personnel retrieve the data requested, while at the others, user personnel retrieve their own. The central repository routinely pushes aperture card engineering data out to the TDCs.

E. POTENTIAL JEDMICS USER CONFIGURATION

1. Planning and Estimation (P&E) Access to Technical Data

Planning and Estimating divisions within NADEP require engineering data in the development of cost estimates, Requests for Manufacture of Articles (RMAs), and Aircraft Maintenance Requests (AMRs).

a. Scenario

The Sheetmetal Planning and Estimating at NADEP North Island has a need to access engineering drawings as a part of the Quick Manufacturing Access Center (QMAC) efforts. The QMAC has the responsibility for providing cost estimates and processing RMAs/AMRs. The average turn around time for completing these actions is approximately 10 working days or 80 hours. Based on interviews with P&Es at NADEP North Island, immediate access to engineering drawings will reduce the time it currently takes by 2 working days or 16 hours. The decrease in turn around time is attributed to a reduction in the time necessary to research each particular sub-assembly of the drawing for completion of the cost estimate or processing of the RMS/AMR.

The research of sub-assemblies can be a time-consuming process. One drawing may be placed on several different aperture cards. This may require that the user order and scan every aperture card associated with a particular drawing in order to find the desired sub-assembly. [Ref.17]

b. Benefit

The implementation of JEDMICS will eliminate the requirements to develop order forms for drawings, wait for

drawings to be collected, reduce research time, and enhance P&E's capability to provide a more accurate estimate.

c. Savings in Cost Estimating Configuration

513 Cost Estimates completed in FY 94
780 A/C Maintenance Requests requiring drawings in FY 94
100 RMA's completed during FY 94
80 hours average turnaround time process
Hourly Wage $27.14 (GS-11/5, salary + fringe)
16 hours estimated savings per action

Calculations:

513 + 780 + 100 = 1393 actions completed
1393 actions completed * 16 hours saved/action = 22,288 hours saved
22,288 hours saved * $27.14 = $604,896 savings

The total wage savings for providing engineering drawings via JEDMICS access, for the P&E at NADEP North Island, is $604,896.

2. Rework Facility Access to Technical Data

Rework facilities repair various aircraft components, many of which are delivered from the fleet. Most of these components, or Aviation Depot Level Repairables (AVDLR's), are considered high priority for repair due to the Mission Essentiality Code (MEC) assigned. The implementation of JEDMICS at these rework facilities would give maintenance personnel access to engineering drawings that are required as part of various repair activities.

a. Scenario

The NADEP North Island rework facilities are physically located .75 hours round trip from the repository. This travel time includes the time required to park and enter the repository, access the engineering drawing, wait for reproduction, or potentially, request drawings and make a second trip.

Travel time required to access engineering drawings is the most quantifiable benefit which can currently be determined at this site.

b. Benefit

Travel time to access engineering drawings as well as the requirement to store aperture cards within each functional area will be virtually eliminated. In addition, the potential for using wrong revisions due to "ghost repositories" being maintained without proper revision control, the possibility of manufacturing wrong parts, or developing items to wrong specifications will be minimized.

c. Savings in Rework User Configuration

Savings in travel time to and from the repository to access engineering drawings for the Rework Facility are provided as follows:

2,374 requests/year
.75 hours each trip
30% chance of required revisit for same data
30 minutes reorientation time
Hourly Wage $27.14 (GS-11/5, salary + fringe)

Calculations:

23,374 requests * .75 hours = 17,530 hours/year
17,530 hours * 30% revisit = 5,259 additional hours/year
17,530 hours + 5,259 hours = 22,789 hours/year travel time
22,789 hours * $27.14 hour = $618,493 wage costs

The yearly savings for no longer having to travel to acquire engineering drawings including restart time will be approximately $618,493 which represents a reduction in travel time of 2,849 days/year.

3. Safety of Flight JEDMICS Capability

When an aircraft is placed out of service, there is a direct effect on mission readiness. As messages are sent from the fleet or other field activities to NADEP North Island, aircraft are grounded and are unable to perform their mission. Engineers at NADEP North Island often require drawings in order to research problems encountered by fleet and field activity maintenance personnel.

a. Scenario

The Production Engineering group at NADEP North Island is responsible for responding to emergencies

regarding safety of flight or Engineering Investigation (EI) questions which may arise from various Naval air field activities and the fleet. Ten percent of the EIs received involve questions which can only be answered by engineers having access to drawings to determine a reason that a particular aircraft may have experienced a major accident/incident.

The inability to access engineering drawings in a timely manner has a significant impact on the capability of the engineer to determine the reason that a particular accident/incident may have occurred. The average response time to these types of questions is approximately 3 working days or 24 hours. The projected improvement in response time is equal to approximately 30% or .90 days. Of the 1,021 EIs received during FY 94, approximately 10% required engineering drawings to properly respond.

b. Benefit

Reducing the turnaround time associated with drawing retrieval will provide a more timely response time to the fleet. A faster response time may effect mission readiness and provide the feedback required to keep aircraft in service.

c. Savings in Production Engineering Configuration

For every day that the engineering group does not have the drawings necessary to make a determination regarding the reason for aircraft downtime, the fleet of aircraft is, in effect, grounded. Savings in the time required for the engineering group to access drawings is provided as follows:

Response Time = 24 hours
Total EIs = 1,021 (FY 94)
Percent Requiring Drawings = 10%
Turnaround Time Improvement = 30%
Hourly Wage $27.14 (GS-11/5, salary + fringe)

Calculations:

1,021 Total FY 94 EIs * 10% = 102.1 EIs
102.1 EIs/Drawings * 24 hours = 2,450.4 hours
2,450.4 hours * 30% improvement = 735.12 hours saved
735.12 hours saved * $27.14 = $19,951.16

The reduced response time as a result of implementing JEDMICS within the Production Engineering group would yield a potential annual savings of $19,951.16.

A summary of anticipated annual savings using JEDMICS is presented in Table 1.

Benefit Title	Potential Annual Savings
Aperture Card Mailing	$ 335,750
Phone Call User Configuration	$ 127,727
Cost Estimating Configuration	$ 604,896
Rework User Configuration	$ 618,943
Production Engineering Configuration	$ 19,951
Total	**$1,707,267**

Table 1. Summary of Annual Savings

F. SUMMARY

The information presented in this chapter addresses the potential cost savings associated with implementing JEDMICS solely at the NADEP North Island CA. Appendix B. provides a summary of the estimated total investment costs and savings related to DoD-wide implementation of JEDMCIS. All figures shown in Appendix B. are in FY 1993 constant dollars and use a present value discount factor of 10%. Chapter V will present the conclusions and recommendations formulated from this study.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Aperture Card Storage

There are several conclusions that can be drawn from the discussions presented in this thesis. A JEDMCIS/JCALS/CITIS shared database does provide a feasible alternative to the current aperture card storage and maintenance process. The implementation of a JEDMICS/JCALS/CITIS shared database does not, however, completely eliminate the need for aperture cards at this point. In order to totally eliminate the need for aperture cards, every contractor that does business with the DoD must have a CITIS capability. Due to the small size and the scope of service many contractors provide, mandating the development of a CITIS system may not be feasible or may force a contractor to cease doing business with the government.

2. Aperture Card Cost Driver

The major cost driver for the current aperture card storage process is the time it takes to acquire data. The cost savings scenarios presented in Chapter IV all represent time savings for various functions within NADEP North Island

when accessing engineering drawings. Since NADEPs throughout the Navy operate in similar fashion, the potential savings at NADEP North Island could be applied to all maintenance facilities.

The maintenance and physical storage of aperture cards may be eliminated as technological integration occurs within the DoD. Yet, until all defense contractors develop the capability to share engineering data in digital format through CITIS, aperture cards will continue to be the prevalent method of engineering drawing delivery to the government.

3. Virtual Deliverable Issue

The issue of "access" or "ownership" to data and its relationship to CITIS depends on the level of data required by the government. A virtual deliverable is only possible if the contractor is CITIS-capable. The process of acquiring data, whether in hard copy or digital format, remains the same. In the case of MDA, access to drawings is based on the data rights defined in the specific Contract Data Requirement List (CDRL). For example, if the government has purchased unlimited rights to specific data for the F/A-18 C/D aircraft, authorized government

would have the capability to access MDA's EDSS through JCALS/CITIS. There is no specific cost for using CITIS. It is included in the negotiated price for data rights regardless of the data level required.

4. Contractor vs. Government Repositories

The benefits of CITIS are recognized at the user end of the data. Data that was once purchased and duplicated many times for distribution can now be purchased once and accessed by remote locations as often as needed.

The advantages of maintaining engineering data at a contractor's facility eliminates the requirement for large aperture card repositories within the DoD once data rights have been purchased. Additionally, a contractor repository would ensure timely access to the most current revisions of engineering data. There are, however, disadvantages to relying solely on a contractor repository.

Without a secondary storage system, JEDMICS/JCALS/CITIS users are vulnerable to both the economical and physical stability of the contractor providing the required data. If a particular contractor ceases to do business with the government, or a weapon system program is canceled, follow-

JEDMICS/JCALS/CITIS users could also be subject to hardware/software problems encountered at the contractor's facility. Without a secondary storage system, users would not be able to access required data until connectivity problems were resolved. These same connectivity problems are being encountered within the JEDMCIS program itself. As new JEDMICS software releases are introduced, older versions become incompatible. This problem was experienced recently between NATSF and NADEP North Island. A JEDMICS 2.5 version cannot transfer data to a JEDMICS 3.0 version. This software limitation requires all users to have the same version in order to be compatible.

5. JEDMCIS/JCALS/CITIS Benefits

The potential cost savings identified by NADEP North Island facilitate the following re-engineering efforts:

- Reduced engineering and logistics man-hours to obtain data.
- More current engineering data available on-line due to digital exchange.
- Digital inspection that enables concurrent review for acceptance.
- High-capacity digital storage devices that require less space.

B. RECOMMENDATIONS

1. Cost Effective CITIS

The JEDMCIS/JCALS/CITIS method of engineering data storage and retrieval is clearly an improvement over the manual aperture card retrieval process. The cost savings in drawing access time using JEDMICS alone, regardless of a contractors CITIS capability, is justification for investment in this particular shared database system. To achieve total implementation of CITIS throughout the DoD's industrial base, it must be affordable to all potential users. MDA's CITIS provider, Aerotech Services Group Inc., has recognized the potential of using both public and private networks and has developed a standardized CITIS node applicable to businesses of any size.

2. Regionalized JEDMCIS

Unfortunately, CITIS is not used by every DoD contractor, which prevents an industry-wide implementation of the JEDMCIS/JCALS/CITIS technology and requires DoD to maintain its current policy of obtaining aperture cards. Therefore, until all defense contractors are CITIS capable, the regionalized use of JEDMICS will be the best way to transfer and store engineering data within the DoD.

be relied upon without a secondary storage system in place. JEDMICS can act as both the primary and secondary storage for contractor provided data. To promote an integrated environment between the government and industry contractors, CITIS development should be mandated as a CDRL line item in those contracts requiring shared data.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

The potential cost savings presented in Chapter IV are being used as justification for the implementation of a regionalized JEDMICS database within the NADEP North Island and the San Diego area. Further research on the actual savings realized compared to those projected should be conducted to determine the overall effectiveness of the JEDMCIS database.

One of the major drawbacks to CITIS implementation by smaller contractors is the technical expertise required to operate and maintain it. The government may provide level-of-effort funding for the development of CITIS to smaller contractors if it is deemed necessary and is included in the contract price. Another area worthy of further research would be an examination of how to make CITIS implementation cost effective for smaller contractors.

APPENDIX A. GLOSSARY OF TERMS

AFB	Air Frame Bulletin
AFC	Air Frame Change
API	Application Program Interface
CAD	Computer-aided Design
CALS	Continuous Acquisition and Life-Cycle Support
CAM	Computer-aided Manufacturing
CDRL	Contract Data Requirements List
CITIS	Contractor Integrated Technical Information System
COTS	Commercial-Off-The-Shelf
DISN	Defense Information Systems Network
DLA	Defense Logistics Agency
DoD	Department of Defense
DTD	Document Type Definition
ECP	Engineering Change Proposal
EDSS	Engineering Drawing Storage System
EGDW	Engineering Graphics Display Workstation
EI	Engineering Investigation
GD/DDB	Global Dictionary/Dictionary Data Base
GDMS	Global Data Management System
GOSIP	Government Open Systems Interconnection Profile
HMR	Hazardous Material Report
ILS	Integrated Logistics Support
IWSDB	Integrated Weapon System Database

JCALS	Joint Continuous Acquisition and Life-Cycle Support
JEDMICS	Joint Engineering Data Management Information Control System
LAN	Local Area Network
MAN	Metropolitan Area Network
MDA	McDonnell Douglas Aerospace
MDR	Material Discrepancy Report
MIPS	Million Instructions Per Second
MTN	Metropolitan Transport Network
NADEP	Naval Aviation Depot
NATSF	Naval Air Technical Support Facility
NAVICP	Navy Inventory Control Point
NAVWAN	Navy Wide Area Network
RAMEC	Rapid Action Maintenance Engineering Change
RISC	Reduced Instruction Set Computer
TCP/IP	Transmission Control Protocol/Internet Protocol
TIDB	Technical Information Data Base
VDW	Video Display Workstation
WAN	Wide Area Network

APPENDIX B. JEDMCIS REPOSITORY COST WORKSHEETS

COST ELEMENT	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	TOTAL
RECURRING COSTS												
Personnel	45.53	45.53	45.53	45.53	45.53	45.53	45.53	45.53	45.53	45.53	45.53	500.81
Info Tech	4.67	22.66	22.00	8.54	4.15	0.00	0.00	0.00	0.00	0.00	0.00	62.03
Facilities	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	4.36	47.99
Material	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	3.03	33.32
Other	27.53	27.53	27.53	27.53	27.53	27.53	27.53	27.53	27.53	27.53	27.53	302.85
Total	85.12	103.12	102.46	89.00	84.60	80.45	80.45	80.45	80.45	80.45	80.45	947.00
INVESTMENT COSTS												
Investment Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL COSTS	85.12	103.12	102.46	89.00	84.60	80.45	80.45	80.45	80.45	80.45	80.45	947.00

REPOSITORY "AS-IS" COSTS SUMMARY (FY1995 - FY 2005)
BASE YEAR FY 1993 CONSTANT $ (IN MILLIONS)

COST ELEMENT	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	TOTAL
RECURRING COSTS												
Personnel	39.49	38.74	37.01	37.01	37.01	37.01	37.01	37.01	37.01	37.01	37.01	411.32
Info Tech	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Facilities	4.17	4.09	3.99	3.99	3.99	3.99	3.99	3.99	3.99	3.99	3.99	44.16
Material	2.79	5.06	8.38	8.38	8.38	8.38	8.38	8.38	8.38	8.38	8.38	83.26
Other	21.05	20.57	14.31	12.58	11.52	11.52	11.52	11.52	11.52	11.52	11.52	149.14
Total	67.50	68.46	63.69	61.96	60.90	60.90	60.90	60.90	60.90	60.90	60.90	687.89
INVESTMENT COSTS												
Investment Costs	63.46	86.85	49.11	30.25	20.49	0.00	0.00	0.00	0.00	0.00	0.00	250.16
Total	63462.40	86.85	49.11	30.25	20.49	0.00	0.00	0.00	0.00	0.00	0.00	250.16
TOTAL COSTS	63529.90	155.30	112.80	92.21	81.39	60.90	60.90	60.90	60.90	60.90	60.90	938.05

REPOSITORY "TO-BE" COSTS SUMMARY (FY1995 - FY 2005)
BASE YEAR FY 1993 CONSTANT $ (IN MILLIONS)

SAVINGS INVESTMENT RATIO (SIR) -BASE YEAR FY93
CONSTANT DOLLARS (MILLIONS)

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	TOTAL
REPOSITORY BENEFITS												
AS-IS Repository Costs	85.12	103.12	102.46	89.00	84.60	80.45	80.45	80.45	80.45	80.45	80.45	947.00
TO-BE Repository Costs	67.50	68.46	63.69	61.96	60.90	60.90	60.90	60.90	60.90	60.90	60.90	687.91
Repository Benefits	17.62	34.66	38.77	27.04	23.70	19.55	19.55	19.55	19.55	19.55	19.55	259.09
USER BENEFITS												
TO-BE Acquisition/Engineering	0.00	10.04	16.69	16.69	87.69	87.69	85.69	85.69	85.69	14.69	14.69	505.25
TO-BE Depot Maintenance	0.00	2.47	4.83	4.83	4.83	4.83	4.83	4.83	4.83	4.83	4.83	45.94
TO-BE Materiel Management	0.00	10.60	16.74	16.74	16.74	16.74	16.74	16.74	16.74	16.74	16.74	161.26
User Benefits	0.00	23.11	38.26	38.26	109.26	109.26	107.26	107.26	107.26	36.26	36.26	712.45
TOTAL BENEFITS	17.62	57.77	77.03	65.30	132.96	128.81	126.81	126.81	126.81	55.81	55.81	971.54
TOTAL INVESTMENT	63.46	86.85	49.11	30.25	20.49	0.00	0.00	0.00	0.00	0.00	0.00	250.16

Return on Investment Ratio: 3.9 to 1

TOTAL PRESENT VALUE (PV) DOLLARS (MILLIONS) - BASE YEAR FY93

	FY95	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	TOTAL
TOTAL SAVINGS (PV)	14.55	43.38	52.61	40.55	74.99	66.08	59.22	53.77	48.95	19.53	17.80	491.43
TOTAL INVESTMENT (PV)	52.42	65.22	33.54	18.79	11.58	0.00	0.00	0.00	0.00	0.00	0.00	181.55

Savings to Investment Ratio: 2.71 to 1

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17. NADEP North Island Planning and Estimating Log Book.

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